INUVIALUIT WILDLIFE STUDIES

WESTERN ARCTIC WOLF RESEARCH PROJECT

PROGRESS REPORT

APRIL 1989 - JANUARY 1991

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ABSTRACT

During the third and fourth years (April 1989-January 1991) of wolf (Canis lupus) research in the Western Arctic, information was collected on wolf movements, pack structure, pack dynamics, pup production and survival, adult mortality and predation.

In April 1989, 37 wolves (19 females, 18 males) were captured. Nine wolves were recaptured and 28 were captured for the first time. Twenty-one wolves (7 recaptures and 13 new captures) were radio-instrumented for telemetry monitoring. This brought the total of radio-collared wolves to 37; however, not all of the wolves were monitored throughout 1989-90.

In April 1990, 30 wolves (16 females, 14 males) from 7 different packs were captured. Thirteen wolves were recaptured, and 17 were captured for the first time. Ten of the 13 recaptures were equipped with new collars so that they could be monitored for the next two years. The 17 new captures were ear-tagged.

Since February 1987, 112 wolves (58 females, 54 males) have been captured. Seventy-one of the 112 wolves were radio-collared. Forty-one of the wolves captured have died (hunter harvest, natural mortality).

Wolf predation was observed and recorded during monthly telemetry flights. Two intensive predation rate studies were conducted in 1989. Five packs were monitored on a daily basis from 4 - 25 April 1989. One pack was monitored several times each day from 17 July to 2 August 1989. Caribou (Rangifer tarandus) were the primary prey in both predation rate studies.

Dens of 11 wolf packs were located above and below the tree line. Scats were collected from 8 den sites in late August 1989 and 8 den sites at 3 other locations in September 1990. Wolf pup production was determined during the summer and survival monitored until the next spring. Eleven packs were seen with pups in the fall of 1989.

Of 36 radio-collared adult wolves, 8 were killed by trappers, and 2 died of undetermined causes in 1989 and 1990. One tagged wolf was found dead and presumed to have died of natural causes. Wolf skulls and carcasses were purchased from trappers in the study area.

Research on wolves in the Western Arctic will continue until 1993.

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INTRODUCTION

The wolf research program is being conducted because wolves play a major role in the natural ecosystem on Inuvialuit land and they are an important resource for the Inuvialuit. The research program began in 1987 with the objective of determining general ecological parameters of wolves and their relationship with prey species in the study area. Results from the study will contribute to the overall scientific understanding of wolves in arctic environments and provide the Inuvialuit and associated management boards and agencies, with information on which to base future conservation decisions. The Inuvialuit are interested in maintaining a wolf population that is a part of the natural environment and is also available for sustainable consumptive use.

This report provides a summary of the wolf research conducted within the Inuvialuit Settlement Region from April 1989 to January 1991. The goals of the study during this period were as follows:

1. to better define and evaluate the relationship between wolves and caribou within the range of the Bluenose caribou herd, using research data and indigenous knowledge;
2. to collect information on wolf movements, pack structure, and range use;
3. to obtain data on wolf productivity and cohort survival; and,
4. to supplement prior information gathered on wolf movements, pack dynamics, predation, den locations, pup survival and adult mortality.

For details on the background, goals, objectives and hypotheses of the wolf research program refer to Clarkson and Liepins (1989a and b).

STUDY AREA

The Western Arctic wolf study area is a 140,000 sq. km tract of land stretching 600 km from east to west and approximately 250 km from north to south (Figure 1). The communities of Inuvik, Tuktoyaktuk, Paulatuk and Colville Lake border on the area. The climate is polar continental, with long periods of extreme cold in winter, short cool summers and light precipitation (Canada, Atmospheric Environment Services 1982). The study area encompasses two physiographic regions; Arctic Coastal Plateaus and Interior Plateaus and Plains (MacKay 1963). The predominant vegetation types are sedge tundra, shrub tundra, forest-tundra transition and open forest. The area is inhabited by a variety of wildlife species which form the basis of the local economies of hunters and trappers from Inuvik, Paulatuk, Tuktoyaktuk, Ft. Good Hope and Colville Lake. For a more detailed description of the study area refer to Clarkson and Liepins (1989a).

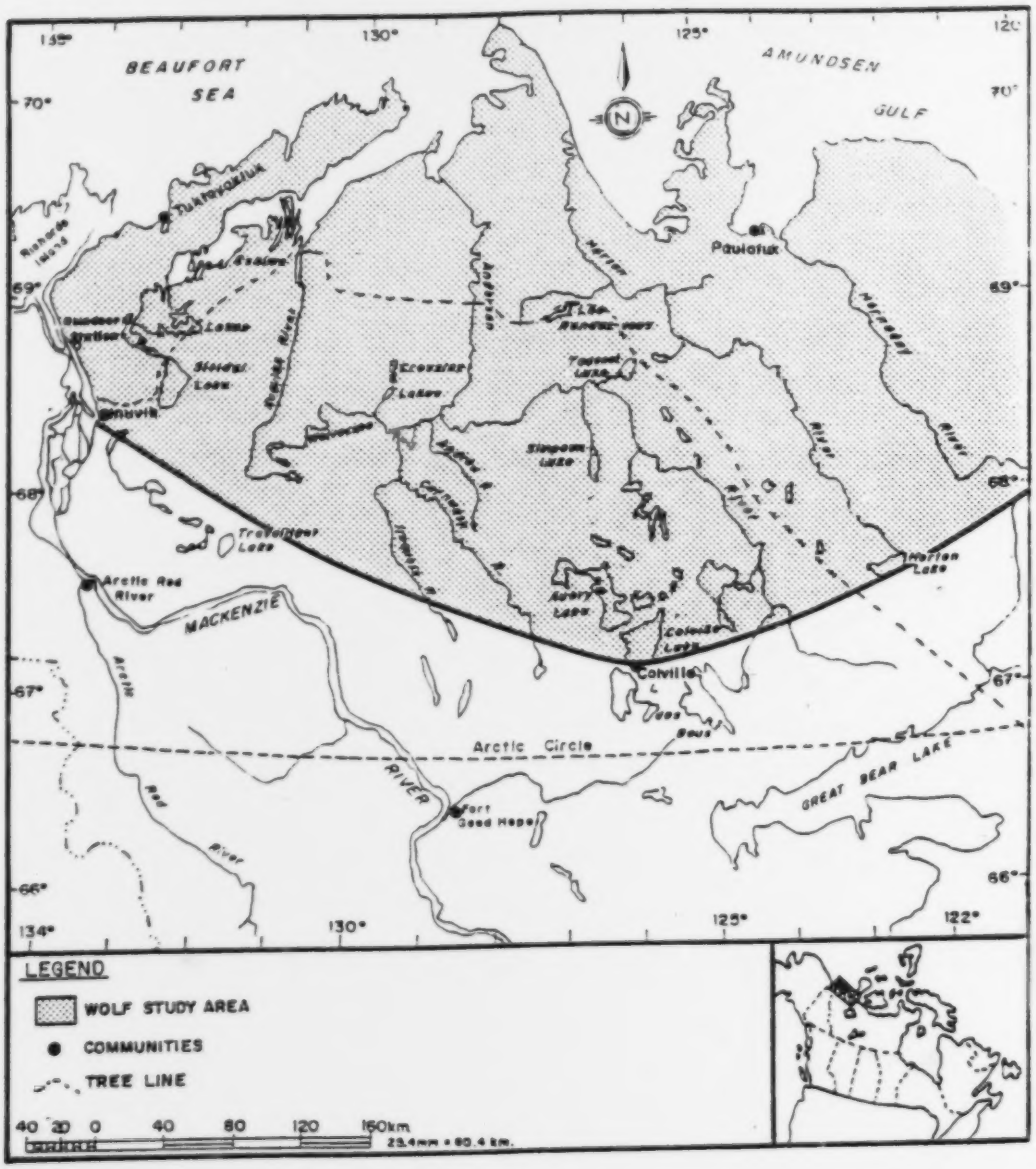

Figure 1. Western Arctic Wolf Research Study Area, 1987-90.

METHODS

Capture efforts in April 1989 and 1990 were directed towards replacing radio-collars on wolves that had been monitored in previous years so that contact could be maintained. Research methods were consistent among years unless otherwise indicated.

Collared wolves and their associated packs were located with a single engine airplane (Piper PA12) and then immobilized from a helicopter (Bell 206) by intramuscular injection of Telazol (A.H. Robins) administered by rifle-fired darts (Pneu-Dart Inc., Williamsport, PA.). First time captures were marked with serially numbered plastic ear tag (Western Industrial Research, Edmonton, Alberta). Wolves were measured and examined to determine physical condition (Clarkson and Liepins 1989a). A premolar was removed from yearling and older wolves, then aged in a lab by reading cementum annulations (Stephenson and Sexton 1974). Pups were identified in the field using tooth wear and eruption (Van Ballenberghe and Mech 1975).

In 1990, a green dye (Kemco Animal Tattoo Ink Paste, Ketchum Manufacturing Sales Ltd., Ottawa, Ontario) was used to mark the fur of some captured wolves temporarily so that they could be identified from the helicopter when attempts were made to capture other pack members at a later date.

In 1990, blood sera were collected from captured wolves and submitted to Dr. L. Forbes (Agriculture Canada, Saskatoon, Saskatchewan) to test for brucellosis. Additional sera sent to Dr. L. Wilber (National Veterinary Services Laboratories, U.S. Department of Agriculture, Ames, Iowa) will be tested using techniques to detect antibodies for canine distemper, canine parvovirus, and canine hepatitis.

Wolf genetic studies were conducted to help understand the extent of wolf movements and mixing throughout the study area. In the first study, genetic differences were determined using starch gel electrophoresis techniques (Kennedy et al. 1991). The second

study investigated genetic relationships among wolves within and among packs by analyzing mitochondrial DNA (Lehman et al. 1992).

All pack members thought to be sexually mature were equipped with radio-collars (Lotek Engineering Inc., Aurora, Ontario; Telonics Inc., Mesa, Arizona). The life expectancies of radio-collars ranged from 2 to 4 years. When available, collars were placed on subadult wolves to monitor their dispersal and movements.

Radio-collared wolves and their associated packs were relocated using conventional aerial radio-relocation procedures (Mech 1974). Telemetry surveys were conducted each month except during December and January when there was insufficient daylight to fly. Wolf movements and predation rates were monitored daily in April, and from 17 July through 2 August 1989. Consumption rates were calculated based on the assumption that wolves were able to consume 80% of a caribou's whole body weight. Five packs were monitored daily in April and 1 pack was monitored several times each day during the summer survey. Visual confirmation of the wolves allowed collection of data on pack structure, habitat use, reproduction and predation. During the summer and fall monitoring flights the number of pups in each pack was recorded. In general, if a wolf pack produced a litter, the pups were seen travelling with the pack in September.

During telemetry monitoring flights and wolf capture work the location of all potential kill sites observed were recorded on data sheets and when possible a ground investigation was conducted. An intact femur was collected and the bone marrow was analyzed for fat content (Neiland 1970). Marrow from other long bones was analyzed when the femur could not be found. Mandibles were collected, measured and analyzed to determine marrow fat content if long bones were not available. An incisor was collected to determine age by reading cementum annulations (Matson's Lab, Milltown, Montana).

Den sites located during monitoring flights were investigated in August or September after the wolves had left the area. A general description of the topography and den was completed. Soil samples were collected at the dens in 1989 to determine soil type.

Scat samples collected in 1989 were analyzed by Loran Karnis (Whitehorse, Yukon). Karnis identified and classified food remains through a visual examination of the scats and identified prey species using impressions of hair scale patterns (Kennedy and Carbyn 1980). In 1990, scats were collected at denning areas and will be analyzed at a later date.

Skulls and carcasses were purchased from trappers to obtain information on body condition and morphology from wolves harvested in the study area. All carcasses were necropsied to determine physical condition, reproductive history and age. Wolf skulls were cleaned and will be measured at a later date. The sex and age data from harvested wolves will be compared with those of captured wolves, and used to get a total sex and age composition for the wolf population in the study area. Reproductive tracts were removed from carcasses and examined to determine reproductive history. For the purpose of this report wolves killed by hunters or trappers are referred to as "taken by a trapper".

RESULTS

The results of research conducted from April 1989 to January 1991 are preliminary. Data collection and analyses are ongoing.

Wolf Capture

Thirty-seven wolves (19 females, 18 males) associated with 9 packs were captured in April 1989 (Table 1). Radio-collars were replaced on 6 of the 7 previously collared wolves. Two other wolves captured in 1988, but not collared at that time were radio-collared when captured in 1989. Thirteen of the 28 first-time captures were fitted with radio-collars.

In April 1990, 30 wolves (16 females, 14 males) from 7 different packs were captured (Table 1). Thirteen wolves were recaptured, and 17 were captured for the first time. Ten of the 13 recaptures were equipped with new collars.

Collared Wolves and Pack Status

Twenty-two radio-collared wolves were located in 1990 (Table 2). Eight collared wolves that were not located in 1990 may have dispersed from the study area or no longer had operational collars. Eight wolves were monitored until they were shot by hunters (F31, M32, F38, F43, M45, F72, F73, F90), and 2 wolves (F14, F60) died of unknown causes. The sex and age composition and the number of individuals continually changed in some packs. Some dominant males and females have been able to maintain stable packs over the past 4 years (Table 3). New packs are formed when some pack members disperse, are taken by trappers, or die of natural mortality. Tables 2 and 3 summarize the status of collared wolves and their associated packs.

Table 1. Wolf captures and confirmed mortalities by year, Western Arctic Wolf Research, 1987-90.

Wolf[1]	Current or Last Known Pack Affiliation	Age[2]	Capture/Mortality year[3] 87	88	89	90
F1	Husky Lakes	1	CM	-	-	-
M2	Husky Lakes	1	CM	-	-	-
F3	Williams Lake	1	C	-	-	C
M4	Sitidgi Lake	1	C	-	M	-
F5	Whale Point	6	C	-	-	-
F6	500 Lake	1	CM	-	-	-
M7	500 Lake	1	CM	-	-	-
M8	Dennis Lake	1	CM	-	-	-
F9	Old Man Lake	0	CM	-	-	-
M10	Old Man Lake	1	CM	-	-	-
F11	Dennis Lake	3	CM	-	-	-
F12	Miner River	4	CM	-	-	-
M13	Wolverine River	8	CM	-	-	-
F14	Wolverine River	3	C	C	M	-
F15	Wolverine River	0	C	C	-	C
M16	Wolverine Dispersal	0	C	-	-	-
M17	Lucifer	1	C	M	-	-
F18	Anderson River	2	C	-	C	-
M19	Anderson River	1	C	-	C	C
M20	Horton River	0	CM	-	-	-
F21	Horton River	0	CM	-	-	-
F22	Granet Lake	1	C	M	-	-
F23	Smoke River	1	C	M	-	-
M24	Tedji Lake	7	C	M	-	-
F25	Tadenet Lake	0	C	-	-	-
F26	Ridge	3	C	-	M	-
F27	Ridge	0	C	-	C	-
F28	Ridge	0	C	-	-	-
F29	Lac Rendez-vous	2	C	-	C	C
F30	Lac Rendez-vous	1	C	-	-	C
M31	Zip Lake	1	C	-	CM	-
M32	Ridge	2	C	C	-	M
M33	Ewariege	1	C	M	-	-
F34	Andrew River	1	C	M	-	-
M35	Anderson River	1	C	M	-	-
F36	Zip Lake	2	C	-	-	-
M37	Lone Wolf	1	CM	-	-	-

[1] F = female, M = male, number = sequential capture number

[2] Age = at first capture, based on cementum analysis, and tooth eruption and wear

[3] C = capture, M = mortality, wolves were captured in March 1987, and in April 1988, 1989, 1990, except M39w was captured in August 1987.

Table 1. Wolf captures and confirmed mortalities by year, Western Arctic Wolf Research, 1987-90. (continued)

Wolf[1]	Current or Last Known Pack Affiliation	Age[2]	Capture/Mortality year[3] 87	88	89	90
F38	Hars	1	C	-	C	M
F39b	Horton River	1	C	M	-	-
M39w	Melville Hills	2	C	-	-	-
M40	Wolverine	2	-	C	-	C
F41	Lucifer	3	-	CM	-	-
F42	Lucifer	5	-	CM	-	-
F43	Tadenet	0	-	C	CM	-
M44	Sundog	0	-	C	-	-
M45	Hars	2	-	C	-	M
M46	Melville	0	-	C	-	-
M47	Erly	1	-	C	M	-
F48	Unknown	5	-	CM	-	-
F49	Wolf Lakes	1	-	C	-	C
M50	Ridge Dispersal	0	-	C	-	-
M51	Luemat	1	-	C	C	-
M52	Iroquois	2	-	C	-	-
M53	Wolverine	0	-	C	-	-
F54	Unknown	0	-	C	M	-
F55	Unknown	1	-	C	-	-
F56	Erly	2	-	C	M	-
M57	Erly	2	-	C	-	-
F58	Erly	1	-	C	-	-
M59	Horton River	0	-	C	-	-
F60	Horton River	10	-	C	C	M
M61	Horton River	0	-	C	-	-
F62	Horton River	0	-	CM	-	-
M63	Horton River	0	-	C	-	-
F64	Horton River	1	-	C	-	-
F65	Anderson River	1	-	C	-	-
F66	Anderson River	1	-	C	-	-
M67	Williams Lake	1	-	-	C	C
M68	Williams Lake	0	-	-	C	-
M69	Mason River	0	-	-	C	-
M70	Lac Rendez-vous	0	-	-	C	C
F71	Luemat	0	-	-	C	-
F72	Ridge	0	-	-	C	M
F73	Island	1	-	-	C	CM

[1] F = female, M = male, number = sequential capture number

[2] Age = at first capture, based on cementum analysis, and tooth eruption and wear

[3] C = capture, M = mortality, wolves were captured in March 1987, and in April 1988, 1989, 1990, except M39w which was captured in August 1987.

Table 1. Wolf captures and confirmed mortalities by year, Western Arctic Wolf Research, 1987-90. (continued)

Wolf[1]	Current or Last Known Pack Affiliation	Age[2]	Capture/Mortality year[3] 87	88	89	90
M74	Island	2	-	-	C	C
F75	Island	0	-	-	C	C
M76	Hars	0	-	-	C	-
M77	Hars	0	-	-	C	-
F78	Iroquois	1	-	-	C	-
M79	Iroquois	0	-	-	C	-
F80	Iroquois	2	-	-	C	-
F81	Anderson	0	-	-	C	-
M82	Anderson	0	-	-	C	-
M83	Anderson	0	-	-	C	-
M84	Anderson	0	-	-	C	-
M85	Ridge	0	-	-	C	-
M86	Wolf Lakes	0	-	-	C	-
F87	Wolf Lakes	0	-	-	C	-
M88	Wolf Lakes	0	-	-	C	-
F89	Wolf Lakes	0	-	-	C	-
F90	Wolverine	1	-	-	C	M
F91	Wolverine	3	-	-	C	C
M92	Mason River	0	-	-	C	-
M93	Horton River	0	-	-	C	M
F94	Horton River	0	-	-	C	-
F95	Williams	0	-	-	-	C
F96	Williams	0	-	-	-	C
F97	Williams	0	-	-	-	C
M98	Lac Rendez-vous	0	-	-	-	C
F99	Anderson	0	-	-	-	C
M100	Anderson	0	-	-	-	C
M101	Island	1	-	-	-	C
M102	Island	0	-	-	-	C
M103	Island	0	-	-	-	C
F104	Island	0	-	-	-	C
F105	Wolf Lakes	0	-	-	-	C
F106	Wolf Lakes	0	-	-	-	C
M107	Anderson	1	-	-	-	C
F108	Anderson	0	-	-	-	C
M109	Wolverine	0	-	-	-	C
F110	Wolverine	0	-	-	-	C
M111	Wolverine	0	-	-	-	C

[1] F = female, M = male, number = sequential capture number

[2] Age = at first capture, based on cementum analysis, and tooth eruption and wear

[3] C = capture, M = mortality, wolves were captured in March 1987, and in April 1988, 1989, 1990, except M39w which was captured in August 1987.

Table 2. The status of radio-collared wolves and their associated packs, November 1990.

Wolf	Pack (Previous Pack)	Date Initially Collared	Last Location Month/Year
F3	Williams Lake (Sitidgi)	02/87	11/90
F15	Wolverine River	02/87	11/90
M16	Unknown (Wolverine)	02/87	11/89*
F18	Anderson River	03/87	11/90
M19	Anderson River	03/87	11/90
F25	Tadenet Lake	03/87	06/90
F27	Ridge	03/87	11/90
F28	Esker's (Ridge)	03/87	05/89*
F29	Lac Rendez-vous	03/87	11/90
M30	Lac Rendez-vous	03/87	11/90
M39	Melville Hills	08/87	11/90
M40	Wolverine River	04/88	11/90
M44	Sundog (Wolverine)	04/88	11/90
M46	Melville Hills	04/88	09/89*
F49	Wolf Lakes	03/87	11/90
M50	Unknown (Ridge)	04/88	11/89
M51	Luemat Lake (Ridge)	04/89	11/90
M52	Iroquois	04/88	09/89
M67	Williams Lake	04/88	11/90
M68	Williams Lake	04/89	04/89*
M69	Mason River (Williams Lk)	04/89	09/89*
M70	Lac Rendez-vous	04/89	11/90
F71	Luemat Lake (Ridge)	04/89	11/90
M74	Island (Hars)	04/89	09/90
M75	Island (Hars)	04/90	09/90
F80	Iroquois	04/89	09/90
F85	Island (Hars)	04/90	04/90
F89	Wolf Lakes	04/89	11/90
F91	Wolverine River	04/89	11/90
M92	Mason River (Horton)	04/89	09/89*

* suspected mortality, dispersal or failed collar

Table 3. Pack size and number of individuals radio-collared in each wolf pack monitored during 1987-90.

Wolf Pack or Lone Wolf	Wolves (collars) per Pack by Year and Season							
	1987		1988		1989		1990	
	S[1]	F[2]	S[1]	F[2]	S[1]	F[2]	S[1]	F[2]
Williams Lake	-	2 (1)	2 (1)	7 (1)	4 (4)	6 (2)	5 (2)	3 (2)
Wolverine	6 (4)	3 (1)	3 (3)	5 (3)	4 (4)	13(4)	6 (3)	14(3)
Anderson	12(3)	4 (3)	4 (2)	10(2)	6 (2)	12(2)	10(2)	13(2)
Ridge	6 (4)	5 (4)	8 (5)	9 (4)	6 (4)	7 (3)	1 (1)	2 (1)
Lac Rendezvous	2 (2)	2 (2)	2 (2)	6 (2)	3 (3)	3 (3)	4 (3)	10(3)
Melville	-	10(1)	8 (2)	6 (2)	2 (1)	7 (1)	1 (1)	2 (1)
Tadenet	1 (1)	3 (1)	3 (2)	1 (1)	2 (1)	5 (1)	1 (1)	-
Sundog	-	-	1 (1)	2 (1)	1 (1)	3 (1)	5 (1)	6 (1)
Island	-	-	-	-	-	11(2)	10(3)	11(3)
Wolf Lakes	1 (1)	2 (1)	3 (2)	1 (1)	5 (2)	3 (2)	6 (2)	9 (2)
Luemat	-	-	-	-	3 (2)	2 (2)	2 (2)	7 (2)
Iroquois	-	-	3 (1)	1 (1)	4 (2)	2 (2)	5 (1)	1 (1)
Horton	12(4)	11(3)	6 (2)	1 (2)	1 (1)	5 (1)	-	-
Zip Lake	-	-	-	-	6 (2)	7 (1)	-	-
Mason River	-	-	-	1 (1)	3 (2)	1 (1)	-	-
M50	-	-	-	-	-	3 (1)	-	-
Lucifers (M17)	1 (1)	4 (2)	-	-	-	-	-	-
Mackenzie	-	-	-	1 (1)	3 (1)	1 (1)	-	-
Eskers (F28)	-	-	-	4 (1)	4 (1)	-	-	-
Hars	-	6 (1)	4 (2)	9 (2)	7 (4)	3 (1)	-	-
Ewariege (M33)	1 (1)	2 (1)	3 (2)	-	-	-	-	-
Tedgi (F24)	-	2 (1)	15(1)	10(1)	-	-	-	-
Granet Lake	5 (5)	5 (1)	-	-	-	-	-	-
Sitidgi	2 (2)	4 (1)	3 (1)	6 (1)	-	-	-	-
Erly Lake	-	-	2 (2)	3 (2)	-	-	-	-
Smoke River	2 (1)	2 (1)	-	-	-	-	-	-

1 S - Spring (March-May observed pack numbers)
2 F - Fall (September-November observed pack numbers)

Movements and Distribution

Wolf movement and distribution information was recorded during regular telemetry flights. Occasionally a monthly flight was missed because of inclement weather or mechanical problems. Collared wolves and their associated packs continued to use large areas that often overlapped. Some wolves travelled south beyond the study area to the Mackenzie River and Fort Good Hope area. Other wolves have travelled east to the Coppermine area. Radio location data will be analyzed and mapped using Quikmap (ESL Environmental Sciences Limited, Sydney, British Columbia) and Homerange (University of Idaho, Moscow, Idaho) and presented in later reports.

During monitoring of predation rates, 5 packs killed a total of 33 caribou (20 adults - 9 females, 5 males, 6 unknown; 6 yearlings - 5 female, 1 unknown; 5 calves of unknown sex; and 2 caribou of unknown of age and sex). Approximately 90-95% of the carcass was consumed at most caribou kill sites investigated. Often only the rumen, lower leg bones, large pieces of bone and hair were found at the sites.

During regular telemetry monitoring of collared wolves, 33 kills were located (32 caribou and 1 muskox). The kills included 19 adults (9 females, 4 males, 6 unknown), 3 yearlings (1 female, 1 male, 1 unknown), 8 calves of unknown sex, and 2 caribou of unknown sex and age. The muskox was 3 years old.

Predation

The Anderson, Lac Rendez-vous, Ridge, Wolf Lakes, and Wolverine packs were monitored to determine predation rates during 4 - 25 April 1989. The Anderson and Ridge packs had consumption rates of 5.41 and 6.88 kg/wolf/day, respectively (Table 4). The Wolverine pack could only be monitored for 4 days due to logistic problems. We do not feel predation rate data on the Lac Rendezvous and Wolf Lakes packs were complete. Only one kill was located

Table 4. Observed predation and consumption rates of wolf packs monitored during April 1989, Western Arctic Wolf Research.

Wolf Pack (Wolves)	Period Monitored (Days)	No. of Reloc.	Caribou Kills	Pred. Rate (days/kill)	Kg/wolf/Day Monitoring[1] Period	Kg/wolf/Day Reloc.[2]
Lac Rendez-vous (3)	4-25 Apr.(22)	22	1	22.00	.91	.91
Anderson (7)	4-25 Apr.(22)	21	14	1.57	5.41	5.67
Ridge (6)	4-25 Apr.(22)	21	12	1.83	6.88	7.21
Wolf Lake (5)	4-25 Apr.(22)	21	3	7.33	1.45	1.52
Wolverine (4)	4-7 April (4)	4	3	1.30	16.23	16.23

[1] Monitoring period - total days of the study
[2] Relocations - number of days wolves were located during the monitoring period.

Abbreviations:
Reloc. - Relocations
Pred. - Predation

for the Lac Rendez-vous pack. F49, the dominant female from the Wolf Lakes pack, often ran from the aircraft making it difficult to locate her and her pack on a kill.

When monitoring the predation and consumption rates of the Wolverine pack (4 adults and pups at a den) from 17 July to 2 August 1989 (17 days), 7 kill sites were found. Four of the kills were identified as caribou, and 3 as unknown ungulates. One caribou was a large adult male (large velvet covered antlers). It is difficult to estimate consumption rates when the age and sex of the kills cannot be identified. If we assume that all kills made by the Wolverine pack were adult male caribou in mid condition (between lean and prime weight, approximately 125.5 kg) (Dauphine 1976), they would have had a consumption rate of 10.3 kg/wolf/day during the 17 day monitoring period. This consumption rate is high; however, during this time the pack was feeding a minimum of 7 pups. If we assume that the caribou were all yearlings in mid condition (approx. 60 kg, Dauphine 1976) then the consumption rate would have been 4.94 kg/wolf/day.

In September 1989, 177 wolf scat samples were collected from 9 dens. Caribou was the main prey in 55% of the 177 scats analyzed. In September 1990, 412 wolf scat samples were collected from 8 dens and 3 other locations. These scats have not yet been analyzed.

Den Sites

Dens were located for 11 of 17 packs or individuals. Some radio-collared wolves could not be located during the denning period. Other wolves were relocated; however, they were never observed with pups or at a suspected denning area. Collared wolves that had not bred or were not associated with a breeding pack may not have used a den during the summer. Dens were located above and below the tree line. Some packs reused dens from previous years.

Reproduction

Reproductive information was collected from 16 different wolf packs from 1987-90 (Table 5). Wolf pup production and survival data were collected over 4 years for 5 packs, 3 years for 3 packs, 2 years for 3 packs, and 1 year for 5 packs (Table 5). Observed litter size ranged from 1 to 7 pups. The best pup counts were usually made in September or October when they began travelling with the rest of the pack. It was often difficult to determine total pup numbers in packs that used areas below the tree line.

We saw and captured fewer pups in packs in February and April, respectively, than during the previous fall (Table 5). We suspect that the pups died during the winter (November - February). Some packs produced pups and subsequently lost the entire litter by fall or the following April (Table 5).

It appears that some packs may have had 2 adult females that produced pups. The Wolverine River pack had 2 adult females (W15, W91) that were 2 and 3 years old, respectively, in 1989, and 3 and 4 years old, respectively, in 1990. Both females were old enough to produce pups. The large increase in pack size in 1989 (4 to 13 wolves) and 1990 (6 to 14 wolves) and the high number of pups observed (7 minimum) with the pack each fall, suggested that either one female had a large litter or there were two separate litters. During capture work in April 1990 the size and colour of W15's and W19's mammae indicated that both wolves had nursed pups during the past year.

Table 5. Number of pups observed in wolf packs monitored during 1987-90, Western Arctic Wolf Research.

Wolf Pack	Wolf Pups Observed Month-Year/Minimum No. of Pups			
	1987	1988	1989	1990
Anderson	06-87/2 04-88/0	07-88/7 04-89/4	09-89/5 11-89/7 04-90/3	09-90/7
Williams Lake	87/0	09-88/5 04-89/2	04-90/3	09-90/0
Wolverine	09-87/3	06-88/0 11-88/0 04-89/0	06-89/2 07-89/5 11-89/7 04-90/2	09-90/7
Lac Rendez-vous	06-87/5 12-87/2 04-88/0	06-88/5 09-88/4 11-88/4 02-89/1 04-89/1	08-89/4 11-89/3 04-90/1	09-90/6
Ridge	09-87/4	09-88/4 04-89/3	08-89/2 11-89/6	09-90/0
Hars	06-87/5 09-87/4	09-88/5 04-89/3	08-89/1 09-89/1	---
Horton	09-87/5 10-87/5 04-88/5	11-88/7 04-89/3	09-89/3	---
Wolf Lakes	---	09-88/0 10-88/0 04-89/4	04-90/2	09-90/4
Island	---	---	09-87/5 11-89/6 04-90/4	09-90/4
Melville	---	07-88/5	---	09-90/0
Sitidgi	10-87/1	09-88/3	---	---

Table 5. Number of pups observed in wolf packs monitored during 1987-90, Western Arctic Wolf Research. (continued)

Wolf Pack	Wolf Pups Observed Month-Year/Minimum No. of Pups			
	1987	1988	1989	1990
Erly	---	07-88/5 09-88/0 10-88/0	---	---
Luemat	---	---		09-90/5
Iroquois	---	04-89/1	---	---
Tadenet	---	---	09-89/3 11-89/3	---
Zip Lake	---	---	08-89/4 09-89/5 10-89/5	---

Injuries, Diseases and Parasites

Cursory examinations of wolves during capture work (1989 and 1990) provided no evidence of external parasites (fleas, ticks, lice). The pelt and body condition of all wolves captured was rated as good. During capture and monitoring work several wolves were observed to have injuries or abnormalities (Table 6). Cestodes and nematodes were found in the wolf carcasses necropsied.

Blood serum samples (n=29) collected in April 1990 were sent to Dr. F.L. Leighton, University of Saskatchewan, Saskatoon, Saskatchewan; Dr. L.A. Forbes, Agriculture Canada Lab, Saskatoon, Saskatchewan; and Dr. L. Wilber, National Veterinarian Laboratory, Ames, Iowa for disease analysis.

Mortalities

From April 1989 to January 1991, a minimum of 11 marked or collared wolves died. Eight wolves were taken by hunters and trappers and 3 wolves died of undetermined, but probably natural causes. Since the study began in 1987, a minimum of 41 (37%) of the 112 wolves captured have died (Table 7). Of those, 31 (28%) were taken by trappers, 8 (7%) died of natural causes, and 2 (2%) died during capture. Pup mortality varied among packs, with some packs loosing all of their pups and others raising most of their litters to yearlings.

Most of the past reported harvest occurred above the tree line in the Husky Lakes area during the period of October to April (Clarkson and Liepins 1989a). Five radio-collared wolves (F31, M32, F43, F72, F73) were shot in the area south of Husky Lakes by trappers from Tuktoyaktuk. A radio-collared wolf (F90) was shot in January 1990 in the Anderson River area. F38, the dominant female in the Hars pack, was shot on Tadenet Lake in March 1990 by a trapper from Paulatuk. M45 was also shot by a trapper from Paulatuk in March 1990.

Three wolves (F14, F60, both radio-collared, M93 ear-tagged) died of undetermined, but probably natural causes (Table 7). F14 was last seen with the Wolverine pack on 8 November 1988. When conducting a

Table 6. Injuries and abnormalities observed during wolf capture and monitoring work, Western Arctic Wolf Research 1989-90.

Wolf	Injury/Abnormality	Date Observed	Comments
M19	limping	Mar. 88	
M19	missing 2 digits right forepaw	Apr. 89	leghold trap
F27	limping	Apr. 90	
F29	cut below right eye	Apr. 89	
M30	limping	Mar-Apr. 88	
M30	viral papilloma - left eyelid	Apr. 90	
M106	viral papilloma - oral cavity	Apr. 90	
M109	viral papilloma - oral cavity	Apr. 90	
M67	yellow teeth	Apr. 89	poss. dist.
M104	broken ribs	Apr. 90	
F75	opacity in right eye	Apr. 90	
W91	right ear missing	Apr. 90	other wolf

- poss. dist. = possible previous distemper

Table 7. Confirmed mortalities of captured wolves, February 1987 to January 1991, Western Arctic Wolf Research.

Wolf	Age at mortality[1]	Pack	Cause	Mortality Date (Mo/Yr)
1	(1)	Husky Lakes	Trapper	Apr./87
2	1	Husky Lakes	Trapper	Mar./87
4	3	Sitidgi Lake	Trapper	Mar./89
6	1	500 Lakes	Trapper	Mar./87
7	1	500 Lakes	Trapper	Mar./87
8	1	Dennis Creek	Trapper	Mar./87
9	0	Old Man Lake	Capture	Mar./87
10	(1)	Old Man Lake	Trapper	Mar./87
11	3	Dennis Creek	Trapper	Mar./87
12	4	Miner River	Trapper	Mar./87
13	8	Wolverine R.	Natural	May/87
14	6	Wolverine	Natural	May/87
17	2	Lucifer	Trapper	Apr./88
20	(0)	Horton River	Trapper	May/87
21	(0)	Horton River	Capture	Mar./87
22	2	Granet River	Trapper	Apr./88
23	2	Smoke River	Trapper	Apr./88
24	7	Tedgi Lake	Natural	Apr./88
26	5	Ridge	Natural	Feb./89
31	3	Zip Lake	Trapper	Dec./89
32	4	Ridge	Trapper	Jan./90
33	4	Ewariege	Trapper	Apr./88
34	2	Andrew River	Trapper	Apr./88
35	1	Anderson R.	Trapper	Jan./88
37	2	Lone Wolf	Trapper	Apr./87
38	4	Hars	Trapper	Mar./90
39b	2	Horton River	Natural	Apr./88
41	3	Lucifer	Trapper	Apr./88
42	5	Lucifer	Trapper	Apr./88
43	1	Tadenet	Trapper	Nov./89
45	4	Hars	Trapper	Mar./90
47	2	Erly Lake	Trapper	Jan./89
48	5	Unknown	Nat/Cap[2]	Apr./88
54	1	Unknown	Trapper	Mar./89
56	3	Erly Lake	Trapper	Jan./89
60	12	Horton	Natural	Apr./90
62	0	Horton River	Trapper	Apr./88
72	1	Ridge	Trapper	Jan./90
73	3	Island	Trapper	Jan./91
90	2	Wolverine	Trapper	Jan./90
93	1	Horton	Natural	Aug./90

1 age estimated from tooth eruption and wear, other ages estimated from cementum analysis.

2 F48 died after being captured but had a serious wound from a fight with a wolf prior to capture (Clarkson and Liepins 1989b).

monitoring flight on 9 February 1989, we suspected that F14 was dead or had slipped her collar. We confirmed that F14 was dead on 22 April 1989 (collar, bones, and fur were found) indicating she had died sometime between 8 November 1988 and 9 February 1989. The cause of death was not determined. F14 was 6 years old when she died.

F60's radio-collar was located in April 1990 but was left at the site for an investigation when the snow was gone. We confirmed that F16 was dead during a site investigation in June 1990 (collar, bones and hair were found at the site). F60 was 12 years old when she died sometime between October 1989 and April 1990. F60 was likely the dominant female in the Horton pack in 1989 as she was seen with 3 pups in September 1989. The cause of death was not determined; however, natural mortality was suspected.

M93 was captured as a pup with the Horton pack in April 1989. In the fall of 1990, J. Pokiak found the decayed and scavenged carcass of M93 on the west shore of the Anderson River. The appearance of the carcass and its proximity to the river (below the spring flood line) suggested that the wolf had died during the summer of 1990.

Skull and Carcass Collection and Analysis

A total of 15 wolf skulls and 51 carcasses in 1988-89 and 39 skulls and 30 carcasses in 1989-90 was purchased from trappers in the Inuvik Region. Necropsy and skull measurement data will be analyzed with other measurement data from previous years. A total of 180 skulls and 156 carcasses has been submitted by trappers since the study began in 1987. The skull and carcass collection will continue for the remainder of the study.

Genetic Analysis

During 1989 and 1990, 30 samples from 8 different packs and 31 samples from 7 different packs were sent to N. Lehman, University of California at Los Angeles, California, for genetic analysis. Mr. Lehman has completed analysis of the 1989 samples and has included genetic data from our wolves in a paper examining wolf genetics in North America (Lehman et al. In press). He is presently analyzing the genetic samples collected in 1989 and 1990 for a paper discussing wolf pack genetics in our study area.

A paper on wolf genetics for the area was published in the Canadian Journal of Zoology in 1991 (Kennedy et al. 1991). The results of the analysis completed by Kennedy et al. (1991) indicate that wolves throughout the study area are genetically similar. This means that with the amount of wolf movement throughout the study area, dispersal of young wolves from their natal packs and subsequent formation of new packs, there is a mixing of wolf genes throughout the study area.

SUMMARY AND CONCLUSIONS

Since February 1987, 112 wolves (58 females, 54 males) have been captured in the study area. Collars were placed on 71 wolves. Several radio-collared wolves were captured 2 or more times to replace their collar. There are presently 12 wolf packs being monitored to determine movements, distribution, pup production, predation rates and survival. During past research, an additional 13 packs were monitored until their radio-collars stopped transmitting, or the wolves were taken by trappers, died of natural causes or dispersed from the study area.

Wolves captured in April 1989 and 1990 appeared healthy and were in good condition. No external parasites were noticed on any of the captured wolves. Some of the wolves taken by trappers and subsequently necropsied, had low levels of nematodes and cestodes.

Radio-collared wolves and their associated packs have continued to use one of two different range use patterns. Some wolf packs have continued to use relatively small areas and have not undertaken large seasonal migrations with the caribou, while other packs travel in an east and west direction with the caribou. Wolf pack movements and distribution may be a function of pack size and prey availability; however, there seems to be some individual preference for areas and movement strategies. We have seen several packs in close proximity to each other and have recorded some packs travelling through areas that have resident (non-migrating) wolf packs. The lack of any apparent inter-pack aggression may be a result of the high availability of prey, because a large number of caribou migrate through the area. There may be no advantage to defending an area aggressively that may not have any prey species a day or a week later.

Caribou are the main prey species for wolves in the study area. The two predation rate studies conducted in 1989, supported results of earlier studies conducted in 1987 and 1988. Namely that caribou were the main prey species for all packs monitored. Predation on the different sex and age classes varies with the availability of caribou and snow cover. In general, wolves appear to be able to take caribou

at any time of the year, even when they occur at relatively low densities below the tree line during the summer months.

In the spring and summer of 1989 and 1990 den sites were located throughout the study area. Wolf packs that may travel to areas of high seasonal caribou concentrations in February to May will later abandon those areas and travel to past (traditional) denning areas. Wolves have been seen at their dens in late March and early April, but do not have pups until late May. Wolf packs often have several dens within their denning areas. This allows the pack to move their pups to another den if the den site they are using is disturbed. Dens that have been used for several years have a complex structure with many tunnels, chambers and openings. The wolf packs monitored did not appear to leave their den site and use a rendezvous site as wolves in other southern research studies have done. By remaining at a den site the pups are given some protection from grizzly bears that may be in the area. Pups may also escape blackfly and mosquito harassment by taking cover in the den.

Most female wolves 2 years old and older produced pups. Litter size varied, with the average litter being 4 - 5 pups. Some packs appear to have more than one female producing pups. Pup survival varied throughout the study area and is likely a function of how much prey is available to the adult pack members.

From April 1989 to January 1991 a minimum of 11 wolves captured during the study were taken by trappers or died of natural causes. Since the beginning of the study a minimum of 41 (37%) of the 112 wolves captured have died (31 trapper harvest, 8 natural mortalities, 2 capture mortalities). Wolf pup mortality varies among packs, with some packs losing all of their pups and others raising all pups observed in the fall to April of the following year.

Hunters and trappers from the study area continued to assist us by submitting wolf skulls and carcasses. Since the beginning of the study 180 skulls and 156 carcasses have been collected. Not all of the wolf skulls or carcasses submitted are from the study area. Some are from the Aklavik area, and have been collected and measured for later

comparison work between wolves from the east and west sides of the Mackenzie River.

Wolves throughout the study area were genetically similar (Kennedy et al. 1991). Given the amount of wolf movement, overlap in ranges and dispersal throughout the study area, it is not surprising that the wolves are genetically similar.

The Western Arctic Wolf Research Study began in February 1987 and will continue until April 1993. We continue to collect information on wolf-prey relationships.

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Appendix I. Wolves captured during Western Arctic Wolf Research, 1987-90.

Wolf[1]	Capture Coordinates	Age[2]	Sex	Tag/ Tattoo	Weight (kg)
F1	68.48 133.01	1	F	W1/8701	34
M2	68.45 133.14	1	M	W2/8702	41
F3	68.43 132.50	1	F	W3/8703	40
M4	68.45 132.53	1	M	W4/8704	48
F5	68.46 133.28	6	F	W5/8705	36
F6	68.53 132.18	1	F	W6/8706	30
M7	68.53 132.14	1	M	W7/8707	26
M8	68.50 132.26	1	M	W8/8708	43
F9	68.59 132.13	0	F	W9/8709	25
M10	69.02 132.10	1	M	W10/9710	29
F11	68.47 132.28	3	F	W11/8711	32
F12	68.45 131.42	4	F	W12/8712	25
M13	68.39 131.42	8	M	W13/8713	35
F14	68.39 131.42	3	F	W14/8714	25
F15	68.39 131.42	0	F	W15/8715	26
M16	68.39 131.42	0	M	W16/8716	31
M17	68.34 126.45	1	M	W17/8717	28
F18	68.32 126.54	2	F	W18/8718	28
M19	68.36 126.50	3	M	W19/8719	35
M20	68.37 127.34	0	M	W20/8720	27
F21	68.37 127.30	0	F	W21/8721	29
F22	68.33 127.28	1	F	W22/8722	30
F23	68.34 127.28	1	M	W23/8723	32
M24	68.34 127.28	7	F	W24/8724	34
F25	68.22 127.58	0	F	W25/8725	21
F26	68.33 127.54	3	F	W26/8726	20
F27	68.33 127.34	0	F	W27/8727	22
F28	68.34 127.35	0	F	W28/8728	28
F29	68.48 127.09	2	F	W29/8729	31
F30	68.48 127.09	1	M	W1/8730	32
M31	68.37 127.06	1	M	W2/8731	24
M32	68.37 127.06	2	M	W3/8732	31
M33	68.35 126.37	1	M	W4/8733	40
F34	68.33 126.45	1	F	W5/8734	22
M35	68.33 126.45	1	M	W6/8735	27
F36	68.33 127.00	1	M	W7/8736	26
M37	68.42 127.05	2	M	W37/8737	39
F38	68.30 126.52	1	F	W38/8738	26
F39b	68.35 126.58	1	F	W39/8739	20
M39w	69.38 126.42	-	M	W39/8739	21

[1] F = female, M = male, number = sequential capture number

[2] Age = at first capture, based on cementum analysis, and tooth eruption and wear

Appendix I. Wolves captured during Western Arctic Wolf Research, 1987-90. (continued)

Wolf[1]	Capture Coordinates	Age[2]	Sex	Tag/ Tattoo	Weight (kg)
M40	68.50 126.32	2	M	W40/8840	46
F41	68.49 126.25	3	F	W41/8841	36
F42	68.50 126.27	5	F	W42/8842	41
F43	68.38 126.45	0	F	W43/8843	31
F44	68.35 127.00	0	M	W44/8844	41
M45	68.41 126.31	2	M	W45/8845	47
M46	68.23 125.58	0	M	W46/8846	36
M47	68.26 127.37	1	M	W47/8847	39
F48	68.31 125.43	5	F	W48/8848	36
F49	68.33 127.07	1	F	W49/8849	32
M50	68.28 127.04	0	M	W50/8850	34
M51	68.27 127.12	1	M	W51/8851	39
M52	68.32 127.20	2	M	W52/8852	39
M53	68.33 127.10	0	M	W53/8853	38
F54	68.37 126.22	0	F	W54/8854	30
F55	68.37 126.22	1	F	W55/8855	32
F56	68.33 126.05	2	F	W56/8856	35
M57	68.32 126.05	2	M	W57/8857	42
F58	68.33 126.05	1	F	W58/8858	35
M59	68.37 126.25	0	M	W59/8859	33
F60	68.37 126.21	10	F	W60/8860	36
M61	68.37 126.25	0	-	W61/8861	36
F62	68.37 126.25	0	F	W62/8862	38
M63	68.37 126.25	0	M	W63/8863	34
F64	68.37 126.25	1	F	W64/8864	30
F65	68.33 126.32	1	F	W65/8865	33
F66	68.33 126.32	1	F	W66/8866	36
M67	68.47 131.48	1	M	W67/ -	45
M68	68.47 131.48	0	M	W68/ -	44
M69	68.47 131.48	0	M	W69/ -	45
M70	68.47 131.48	0	M	W70/ -	43
F71	68.35 127.48	0	F	W71/ -	25
F72	68.35 127.48	0	F	W72/ -	31
F73	68.39 126.22	1	F	W73/ -	42
M74	68.39 126.22	2	M	W74/ -	43
F75	68.39 126.22	0	F	W75/ -	32
M76	68.39 126.22	0	M	W76/ -	43
M77	68.39 126.22	0	M	W77/ -	40
F78	68.58 125.32	1	F	W78/ -	33
M79	68.59 125.32	0	M	W79/ -	34
F80	68.58 125.32	2	F	W80/ -	33
F81	68.32 126.51	0	F	W81/ -	
M82	68.32 126.51	0	M	W82/ -	41

[1] F = female, M = male, number = sequential capture number

[2] Age = at first capture, based on cementum analysis, and tooth eruption and wear

Appendix I. Wolves captured during Western Arctic Wolf Research, 1987-90. (continued)

Wolf[1]	Capture Coordinates	Age[2]	Sex	Tag/ Tattoo	Weight (kg)
M83	68.32 126.51	0	M	W83/ -	39
M84	68.32 126.51	0	M	W84/ -	39
M85	68.38 127.25	0	M	W85/ -	35
M86	68.38 127.25	0	M	W86/ -	35
F87	68.38 127.25	0	F	W87/ -	40
M88	68.38 127.25	0	M	W88/ -	33
F89	68.38 127.25	0	F	W89/ -	28
F90	68.30 127.40	1	F	W89/ -	35
F91	68.30 127.40	3	F	W91/ -	45
M92	68.38 127.15	0	M	W92/ -	42
M93	68.38 127.15	0	M	W93/ -	36
F94	68.38 127.15	0	F	W94/ -	31
F95	68.52 131.48	0	F	W99/ -	35
F96	68.52 131.48	0	F	W100 -	36
F97	68.52 131.48	0	F	W09/ -	39
M98	68.51 126.32	0	M	W10/ -	36
F99	68.24 126.24	0	F	W11/ -	33
M100	69.36 126.57	0	M	W12/ -	40
M101	69.36 126.57	1	M	W13/ -	42
M102	69.36 126.57	0	M	W14/ -	35
M103	69.36 126.57	0	M	W15/ -	36
F104	68.28 129.50	0	F	W16/ -	30
F105	68.27 125.37	0	F	W50/ -	29
F106	68.27 125.37	0	F	TW51/ -	35
M107	68.27 126.48	1	M	TW52/ -	38
F108	68.27 126.48	0	F	TW53/ -	30
M109	68.28 129.50	0	M	TW55/ -	35
F110	68.28 129.50	0	F	TW56/ -	29
M111	68.28 129.50	0	M	TW57/ -	37

[1] F = female, M = male, number = sequential capture number

[2] Age = at first capture, based on cementum analysis, and tooth eruption and wear